Remarks

The present application has claims 1, 2, 4-6, 8 and 11-21 pending. Claims 11-19 have been withdrawn from consideration in the present application, but not yet canceled. Applicants have herein amended claim 1 and have added new claims 22 and 23. Support for the amendment of claim 1 may be found in the specification at page 7, lines 28-31. Support for new claims 22 and 23 may be found at page 8, lines 6-8, of the specification.

In the December 19, 2009 Office Action, the Examiner rejected the pending claims under 35 USC §103 as obvious over Zuber, et al. (USP 6,156,449) in view of Yano (USP 5,380,806) and Tsai, et al. (USP 6,514,296) and Yoshino, et al. (US Pub. No. 2002/0048654 A1).

Applicants respectfully disagree with the Examiner's position. The Examiner contends that the primary reference, Zuber, teaches a catalyst layer for fuel cells wherein the homogenized ink may be applied to the substrate by various techniques. The Examiner maintains that since the catalyst ink composition of Zuber contains water as a constituent then the ink composition is water-based. This is incorrect.

Zuber does not disclose water-based inks. The catalyst inks of Zuber comprise water in the form of an aqueous 15% NaOH solution. Thus, the ink in Table 1 of Zuber contains 0.98% water and the ink in Table 2 contains 1.56% water. As water is a very minor component of the Zuber inks, they cannot be considered "water-based".

"Water-based" catalyst inks for fuel cells are well known in the industry. In the present application, reference is made, as an example, to EP 731 520 A1 (see the present specification at page 3, lines 22-26). This patent publication (which was submitted in an IDS on February 18, 2004) describes numerous disadvantages associated with organic

solvents and nonaqueous based catalyst inks with respect to fuel cell manufacturing. See column 4, line 26, to column 6, line 44. Besides volatility and toxicity, there are also other hazards and the expense of removing the organic components after application of the ink to the substrate. Additionally, aqueous based catalyst inks, such as those used in the present invention, have been shown to produce electrode with improved performance (see, e.g., EP 731 520 A1 at column 6, lines 41-44).

The catalyst inks of EP 731 520 A1, which are referenced as "water-based" inks in the present application, have 10 wt.% or less of organic components in the liquid medium. As explained above, the inks of Zuber do not met this criterion.

Likewise, the Zuber inks do not met the criterions set forth in the present application. On page 7, lines 4-7, of the specification, water-based catalyst ink compositions are described as comprising "an electrocatalyst, an ionomer resin, **water (as a main solvent)** and a surfactant …" (emphasis added). The catalyst inks of Zuber do not have water as their main solvent.

Additionally, preferred water-based catalyst inks are defined in the present specification as containing "5 to 75 wt.% electrocatalyst, 10 to 75 wt.% of ionomer solution (water based or organic solvent based), **10 to 75 wt.% of deionized water**, 0 to 50 wt.% of organic solvents and 0.1 to 20 wt.% of surfactant with a vapor pressure of 1 to 600 Pa" (page 7, lines 28-31, emphasis added). The inks of Zuber do not have 10 to 75 wt.% of deionized water.

To further distinguish the present invention from Zuber, Applicants have herein amended independent claim 1 to specifically require that the catalyst ink have 10 to 75 wt.% of deionized water, along with the other above outlined concentrations.

Furthermore, Zuber does not teach the use of electrocatalysts, instead carbon black and a decomposable Pt(0) complex are employed (see claim 1 of Zuber). With

respect to the referenced example of Zuber (VB1 based on US 5,234,777), the amount of catalyst present in the ink composition of the example does not meet the new limitation set forth in amended claim 1. In the example, the catalyst has a concentration of 4.3 wt.% (1g catalyst / 22.97g for the total weight of the ink composition) -- thus, outside the range of 5 to 75 wt.% of electrocatalyst required by the present claims.

The Zuber reference is furthermore silent with respect to:

- the leveling step;
- the surfactant having a certain vapor pressure; and
- the surfactant having a certain weight range.

As outlined on page 7, lines 3-13, of the specification, the specified range of vapor pressure is necessary to obtain complete removal of the surfactant during the drying step. As a result, less surfactant remains in the electrode layer, leading to reduced blockage of the catalytic centers in the layer, which in turn results in better electrical performance (see page 7, lines 11-13). Conventional surfactants are high boiling with low vapor pressures, generally below 1 Pascal, and are adsorbed by the catalytic centers of the electrocatalyst, thereby blocking access of the reactants to the catalyst surface.

The catalyst layers and MEAs associated with the present invention show excellent results in electrochemical performance (see page 7, lines 11-13, of the specification and the electrochemical testing results shown in table 1). A cell voltage of 670 mV and 680 mV is obtained at 600 mA/cm^2 for hydrogen/air operation at 1.5 bar. This converts to power densities of 0.402 and 0.408 W/cm^2 (see page 12, line 29, to page 13, line 5, and Table 1).

Under similar conditions (hydrogen/air operation with 1 bar), Zuber reports a cell voltage of 470 mV and 598 mV at 500 mA/cm^2 (see col. 7, line 45, and subsequent lines), which results in markedly lower power densities, i.e., 0.235 and 0.299 W/cm^2.

This comparison underlines the quality of the catalyst layers obtained by the present invention.

None of the other cited references, either alone or in combination, solve the shortcomings of the Zuber reference. Yano discloses a screen printing ink for covering flexible printed circuit boards (see claim 1). The ink of Yano comprises a polyurethane and epoxy component (see the title). The ink does not contain any water, and thus cannot be considered "water-based". To the contrary, the Yano composition is very sensitive to humidity, and has to be prepared under nitrogen atmosphere (see, section "Examples", column 8, lines 30-46).

Yano may disclose the use and a range of a leveling agent, however, Yano does not teach electrocatalyst inks and does not specify the vapor pressure range set forth in the claims of the present application.

Tsai is directed to the manufacture of double-layer bipolar capacitors (see the field of invention). Tsai discloses a printing process for a two-component epoxy material having a useful life of about 30 minutes (see column 29, lines 44-53). Tsai does not disclose any catalyst inks and is silent to the use of a specific surfactant having a certain vapor pressure range.

The Yoshino reference teaches a printing medium (i.e. an ink) for ink-jet applications, which can provide images in high optical density and bright color tone (see section 002 of Yoshino). Yoshino may teaches a range of surfactant > 0.1 wt%, but in a totally different context -- one that is not relevant to the present invention.

In sum, the teachings of Yano, Tsai and Yoshino do not apply to the present invention. A skilled person, when looking for a process to make improved MEAs for PEM fuel cells, would not look to or even consider the teachings of Yano, Tsai and Yoshino.

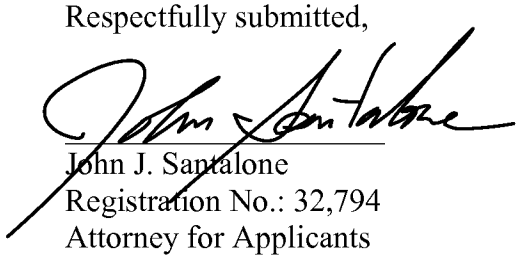
The objective of the present invention is to provide an environmentally safe manufacturing method for catalyst layers, catalyst-coated substrates and MEAs, which have an improved electrical performance in PEM fuel cells (see page 6, lines 1-6, and page 7, lines 12-13). None of the cited references, either alone or in combination, disclose, teach or suggest the claimed invention.

In view of the foregoing remarks and amendments, reconsideration and withdrawal of the rejection under 35 USC §103 and allowance of the application are respectfully requested.

No fee is deemed due with respect to the filing of the present response, other than the fee for the requested three month extension of time. If any additional fees are due, or an overpayment has been made, please charge, or credit, our Deposit Account No. 11-0171 for such sum.

If the Examiner has any questions regarding the present application, the Examiner is cordially invited to contact Applicants' attorney at the telephone number provided below.

Respectfully submitted,



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